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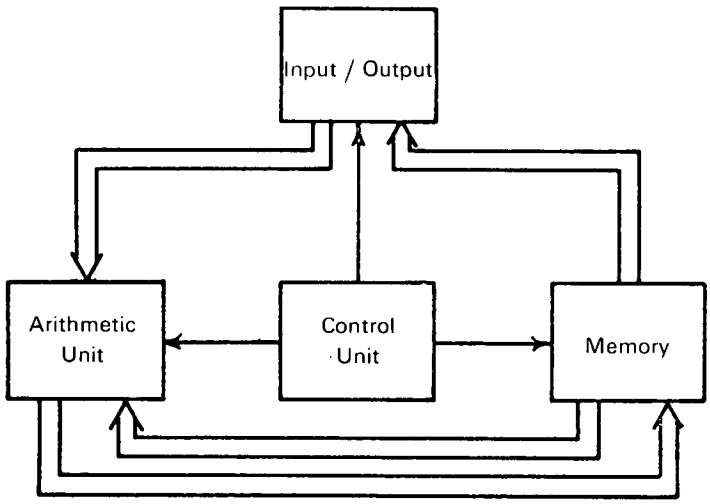
Reducing Quantizer Deadband with a "Range Switching" Digital Filter



Block Diagram of Digital Filter

The problem:

Real-time digital filters referred to as compensators or special purpose computers have the undesirable characteristic of a relatively wide quantization deadband.

The solution:

A range switching digital filter was designed with three predetermined quantization levels. A mathematical program form was selected which physically implemented the transfer function of the filter.

How it's done:

The components of the digital filter and their operation can be explained as follows:

The input-output instrumentation converts the analog input signal of the digital filter into a signed-magnitude digital word for processing by the computer; the operating range of the computer is selected from this digital word. A signed magnitude digital output word is then converted into an analog signal which is the analog output of the filter. The arithmetic unit performs the computations required in order to achieve the mathematical form of the transfer function. The memory performs the time delay function of the transfer equations and provides storage locations for the coefficients and variables. The control unit, composed of a function generator and the data transfer logic, co-ordinates the overall operation of the digital filter.

(continued overleaf)

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Peformance of the filter in the control loop for which it has been designed was considered to be very satisfactory.

Notes:

1. The wide sampling frequency range enables the filter to be compatible in a variety of control loops. It is believed that the use of range switching digital filters will have broad application in future digital control systems.
2. Documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10259

Patent status:

No patent action is contemplated by NASA.

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